**NAME: ANIEROBI UZOAMAKA C**

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**MICTURITION**

**Micturition** is a process by which urine is voided from the urinary bladder. It is a reflex process. However, in grown up children and adults, it can be controlled voluntarily to some extent. The functional anatomy and nerve supply of urinary bladder are essential for the process of micturition.

**FUNCTIONAL ANATOMY OF URINARY BLADDER AND URETHRA**

URINARY BLADDER Urinary bladder is a triangular hollow organ located in lower abdomen. It consists of a body and neck. Wall of the bladder is formed by smooth muscle. It consists of three ill-defined layers of muscle fibers called detrusor muscle, viz. the inner longitudinal layer, middle circular layer and outer longitudinal layer. Inner surface of urinary bladder is lined by mucus membrane. In empty bladder, the mucosa falls into many folds called rugae. At the posterior surface of the bladder wall, there is a triangular area called trigone. At the upper angles of this trigone, two ureters enter the bladder. Lower part of the bladder is narrow and forms the neck. It opens into urethra via internal urethral sphincter.

**URETHRA** Male urethra has both urinary function and reproductive function. It carries urine and semen. Female urethra has only urinary function and it carries only urine. So, male urethra is structurally different from female urethra.

Male Urethra Male urethra is about 20 cm long. After origin from bladder it traverses the prostate gland, which lies below the bladder and then runs through the penis

Throughout its length, the urethra has mucus glands called glands of Littre. Male urethra is divided into three parts:

* Prostatic urethra Prostatic urethra is 3 cm long and it runs through prostate gland. The prostatic fluid is emptied into this part of urethra through prostatic sinuses. Sperms from vas deferens and the fluid from seminal vesicles are also emptied into prostatic urethra via ejaculatory ducts. Part of the urethra after taking origin from neck of bladder before entering the prostate gland is known as preprostatic urethra. Its length is about 0.5 to 1.5 cm. This part of urethra is considered as part of prostatic urethra.
* Membranous urethra Membranous urethra is about 1 to 2 cm long. It runs from base of the prostate gland through urogenital diaphragm up to the bulb of urethra.
* Spongy urethra Spongy urethra is also known as cavernous urethra and its length is about 15 cm. Spongy urethra is surrounded by corpus spongiosum of penis. It is divided into a proximal bulbar urethra and a distal penil urethra. Penile urethra is narrow with a length of about 6 cm. It ends with external urethral meatus or orifice, which is located at the end of penis. The bilateral bulbourethral glands open into spongy urethra. Bulbourethral glands are also called Cowper glands.

**NERVE SUPPLY TO URINARY BLADDER AND SPHINCTERS** Urinary bladder and the internal sphincter are supplied by sympathetic and parasympathetic divisions of autonomic nervous system whereas, the external sphincter is supplied by the somatic nerve fibers

* **SYMPATHETIC NERVE SUPPLY** Preganglionic fibers of sympathetic nerve arise from first two lumbar segments (L1 and L2) of spinal cord. After leaving spinal cord, the fibers pass through lateral sympathetic chain without any synapse in the sympathetic ganglia and finally terminate in hypogastric ganglion. The postganglionic fibers arising from this ganglion form the hypogastric nerve, which supplies the detrusor muscle and internal sphincter.

**Function of Sympathetic Nerve** The stimulation of sympathetic (hypogastric) nerve causes relaxation of detrusor muscle and constriction of the internal sphincter. It results in filling of urinary bladder and so, the sympathetic nerve is called nerve of filling.

* **PARASYMPATHETIC NERVE SUPPLY** Preganglionic fibers of parasympathetic nerve form the pelvic nerve or nervus erigens. Pelvic nerve fibers arise from second, third and fourth sacral segments (S1, S2 and S3) of spinal cord. These fibers run through hypogastric ganglion and synapse with postganglionic neurons situated in close relation to urinary bladder and internal sphincter

**Function of Parasympathetic Nerve** Stimulation of parasympathetic (pelvic) nerve causes contraction of detrusor muscle and relaxation of the internal sphincter leading to emptying of urinary bladder. So, parasympathetic nerve is called the nerve of emptying or nerve of micturition. Pelvic nerve has also the sensory fibers, which carry impulses from stretch receptors present on the wall of the urinary bladder and urethra to the central nervous system.

**SOMATIC NERVE SUPPLY** External sphincter is innervated by the somatic nerve called pudendal nerve. It arises from second, third and fourth sacral segments of the spinal cord.

**Functions of nerves supplying urinary bladder and sphincters Nerve** On detrusor muscle on internal sphincter on external sphincter Function Sympathetic nerve Relaxation Constriction Not supplied Filling of urinary bladder Parasympathetic nerve Contraction Relaxation Not supplied Emptying of urinary bladder Somatic nerve Not supplied Not supplied Constriction Voluntary control of micturition

**Nerve supply to urinary bladder and urethra**

**Function of Pudendal Nerve** Pudendal nerve maintains the tonic contraction of the skeletal muscle fibres of the external sphincter and keeps the external sphincter constricted always. During micturition, this nerve is inhibited. It causes relaxation of external sphincter leading to voiding of urine. Thus, the pudendal nerve is responsible for voluntary control of micturition.

**MICTURITION REFLEX** Micturition reflex is the reflex by which micturition occurs. This reflex is elicited by the stimulation of stretch receptors situated on the wall of urinary bladder and urethra. When about 300 to 400 mL of urine is collected in the bladder, intravesical pressure increases. This stretches the wall of bladder resulting in stimulation of stretch receptors and generation of sensory impulses.

Pathway for Micturition Reflex Sensory (afferent) impulses from the receptors reach the sacral segments of spinal cord via the sensory fibers of pelvic (parasympathetic) nerve. Motor (efferent) impulses produced in spinal cord, travel through motor fibers of pelvic nerve towards bladder and internal sphincter. Motor impulses cause contraction of detrusor muscle and relaxation of internal sphincter so that, urine enters the urethra from the bladder. Once urine enters urethra, the stretch receptors in the urethra are stimulated and send afferent impulses to spinal cord via pelvic nerve fibers. Now the impulses generated from spinal centers inhibit pudendal nerve. So, the external sphincter relaxes and micturition occurs. Once a micturition reflex begins, it is self-regenerative, i.e. the initial contraction of bladder further activates the receptors to cause still further increase in sensory impulses from the bladder and urethra. These impulses, in turn cause further increase in reflex contraction of bladder. The cycle continues repeatedly until the force of contraction of bladder reaches the maximum and the urine is voided out completely. During micturition, the flow of urine is facilitated by the increase in the abdominal pressure due to the voluntary contraction of abdominal muscles.

Higher Centers for Micturition Spinal centers for micturition are present in sacral and lumbar segments. But these spinal centers are regulated by higher centers. The higher centers, which control micturition are of two types, inhibitory centers and facilitatory centers. Inhibitory centers for micturition Centers in midbrain and cerebral cortex inhibit the micturition by suppressing spinal micturition centers. Facilitatory centers for micturition Centers in pons facilitate micturition via spinal centers. Some centers in cerebral cortex also facilitate micturition.

**Micturition reflex**

**ABNORMALITIES OF MICTURITION**

**ATONIC BLADDER – EFFECT OF DESTRUCTION OF SENSORY NERVE FIBERS**

Atonic bladder is the urinary bladder with loss of tone in detrusor muscle. It is also called flaccid neurogenic bladder or hypoactive neurogenic bladder. It is caused by destruction of sensory (pelvic) nerve fibers of urinary bladder. Due to the destruction of sensory nerve fibers, the bladder is filled without any stretch signals to spinal cord. Due to the absence of stretch signals, detrusor muscle

loses the tone and becomes flaccid. So, the bladder is completely filled with urine without any micturition. Now, urine overflows in drops as and when it enters the bladder. It is called overflow incontinence or overflow dribbling.

**NOCTURNAL MICTURITION** Nocturnal micturition is the involuntary voiding of urine during night. It is otherwise known as enuresis or bedwetting. It occurs due to the absence of voluntary control of micturition. It is a common and normal process in infants and children below 3 years. It is because of incomplete myelination of motor nerve fibers of the bladder. When myelination is complete, voluntary control of micturition develops and bedwetting stops.

If nocturnal micturition occurs after 3 years of age it is considered abnormal. It occurs due to neurological disorders like lumbosacral vertebral defects. It can also occur due to psychological factors. Loss of voluntary control of micturition occurs even during the impairment of motor area of cerebra